FUNCTIONAL GROUP CHARACTERISATION AND COMPARATIVE STUDY OF NATURAL HERBS EXTRACTION OIL *ALEURITES MOLUCCANA, CINNAMON ZEYLINICUM, MYRISTICA FRAGRANS, PIPER NIGRUM* WITH *ZEA MAYS, AND ELAEIS GUINEENSIS JACQ. OIL*

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"I hereby acknowledge that I had read this technical writing and in my opinion the technical writing is sufficient in terms of scope and quality for the purpose of the granting of Bachelor of Chemical Engineering"

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"I declare that this thesis is the result of my own research except as cited references. The thesis has not been accepted for any degree and is currently submitted in candidate of any degree."

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I dedicate my joy of my successful undergraduate project to my beloved family and friends.

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ABSTRACT

The research about variety of natural sources to get the specialty oil has been actively conducted now. Four types of herbs which are easy to find in Malaysia consist of *aleurites moluccana*, *cinnamon zeylinicum*, *myristica fragrans, and piper nigrum* were selected as sample in this research. Analysis has been done for the percentage yield of oil and functional group of oil by using the FTIR spectroscopy. From the analysis *aleurites moluccana* given the highest percentage yield about 67.02% and *cinnamon zeylinicum show* the lowest percentage yield 32.99%. Comparison of commodity oil (palm oil and maize oil) with the specialty oil has been done and the result shows that *aleurites moluccana* oil is almost the same Infra-Red spectrum with palm oil and maize oil. The development for this type of oil must be considered because it has a good potential to commercialize. The market value for this type of oil is now increasing in its application and can substitute the oil from animal fats.

ABSTRAK

Penyelidikan mengenai kepelbagaian sumber bagi menghasilkan minyak istimewa semakin giat dijalankan kini. Empat jenis herba yang mudah didapati di Malaysia iaitu buah *aleurites moluccana*, *cinnamon zeylinicum*, *myristica fragrans, and piper nigrum* telah dipilih sebagai sampel di dalam kajian ini. Penganalisaan terhadap kadar penghasilan minyak dan kumpulan berfungsi minyak yang terhasil menggunakan FTIR telah dijalankan dalam kajian ini. Daripada penganalisaan yang telah dibuat, minyak yang terhasil daripada *aleuritus moluccana* memberikan peratus penghasilan yang paling tinggi iaitu 67.02% manakala minyak *cinnamon zeylinicum* menunjuk peratus penghasilan yang paling rendah iaitu 32.99%. Perbandingan antara minyak pasaran (kelapa sawit dan jagung) dengan minyak istimewa dijalankan dan keputusan menunjukkan minyak daripada *aleurites moluccana* menunjukkan Infra-Merah spektrum yang hampir sama dengan minyak kelapa sawit dan juga minyak jagung Pembangunan untuk kajian minyak istimewa ini perlulah dipertimbangkan sekarang kerana ia mempunyai potensi yang cerah untuk dikomersialkan. Nilai pasaran untuk minyak istimewa sekarang telah meningkat di kebanyakan tempat di dunia kerana penggunaannya yang luas dan juga sebagai minyak gantian untuk minyak yang dihasilkan daripada lemak binatang.

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FTIR - Fourier Transform Infra Red

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Interest in specialty oils has revived in recent decades, with the popularity of aromatherapy, a branch of alternative medicine which claims that the specific aromas carried by specialty oils have curative effects. Although it being produce in a small quantity compare to other food oil such as cooking oil from palm oil, soybean oil and maize oil but the specialty oil have a very high price in the market. This is because it being use in specific area especially in cosmetic and medical (Spricigo *et al*., 1999).

Specialty oils are generally extracted by distillation. Other processes include solvent extraction which is a very simple method to get the specialty oil. Usually, the specialty oil can be extract from various raw materials from fruit seeds, bark, leaves, roots, and flowers. (McClatchey, 2002)

In this study the productions of specialty oil are extracted from herbs like *aleurites moluccana, cinnamon zeylinicum, myristica fragrans, and piper nigrum.* All of this oil cannot be use in food oil because of it produce in very small quantity of oil.

1.2 Problem Statement

Nowadays, synthetic chemical and drugs are largely being use as medicine and it is majorly give the bad impact to the human health if it takes over dosage. In order to reduce the usage of synthetic chemical as medicine, there are alternative ways by using the natural resources such as herbs.

Several herbs have been chosen to study whether it has potential to become the alternative medicine and cosmetics by compare the functional group of each herb. Four types of herbs have been chosen are *aleurites moluccana*, *cinnamon zeylinicum*, *myristica fragrans, and piper nigrum*.

Several research groups around the world have succeeded in finding and identifying natural antioxidants from herbs and spices using different model systems. Cinnamon (*Cinnamomum zeylanicum* Blume, syn C. verum, family Laureceae) is a widely used spice and have many applications in perfumery, flavoring and pharmaceutical industries. (Singh *et al.*, 2007).

Myristica fragrans essential oil is used in bakery products, dehydrated soups, ice-cream, sauces and processed meat. It is also applied in medicinal drug, perfume and shampoo formulations. In aromatheraphy, it is used as a stimulator and energizer. (Spricigo *et al.,* 1999).

Aleurites moluccana oil used for treating burns, cold sores, as traditional therapeutic massage oil, and preventing stretch marks during pregnancy. More recently, the oil has been used in cosmetic products because of its unique emollient properties (Ako *et al*., 2005).

1.3 Objective

The objective of this research is to produce and analyze the functional group of the specialty oil. The comparative study of functional group has being done with the palm oil and maize oil.

1.4 Scope of study

The scopes of the study are:

i. To extract the specialty oil from the various type of herbs (*aleurites moluccana, cinnamon zeylinicum, myrictica fragrans, piper nigrum*) . The specialty oil is extract by using the Soxhlet extractor.

ii. To analyze the functional group of specialty oil by using the Fourier Transform Infra Red Spectrometer.

iii. To compare functional group of the sample with the maize oil and palm oil.

CHAPTER 2

LITERATURE REVIEW

2.1 Specialty Oil

Specialty oil is the fragrant essence of plant in their purest, most concentrated state. It have different properties from other oil especially the commodity oil that being use as the cooking oil. This specialty oils are usually sell in small amount but very high price because it is very difficult to get pure oil from the raw material.

Almost all the specialty oils are being use in the cosmetic, aroma therapy, and also as the medicine for external use. (Ako *et al*., 2005)Maybe for another decade, this specialty oil can be the one of the major use in medicine replace the chemical usage for the medicine.

2.2 Functional Group

In organic chemistry, functional groups are specific groups of atoms that are responsible for the characteristics chemical reaction of molecules. Although there are a wide variety of organic compounds, most of them are composed of the elements from the upper right hand portion of the periodic chart: C, H, N, O, S halogen.

These compounds can be categorized by certain structural and reactive features, dictated by the way carbon bonds to itself or another element, e.g. carbon double bonded to oxygen. Such a grouping of compounds provides us with the concept of chemical families. These special bonding arrangements have different reactivities or functions and associated with each family is particular functional group.

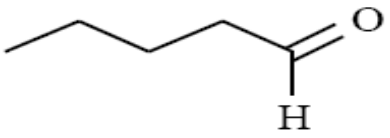
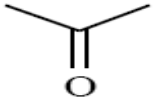
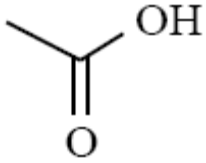
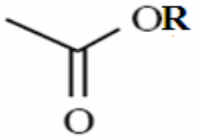
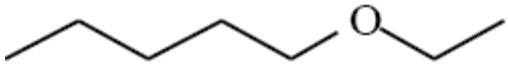
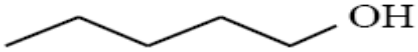
The functional group is not the whole molecule but only that collection of atoms that provides a specific chemical function. For example, the chemical family of alcohols is characterized by the function of the hydroxyl (OH) group, and aldehydes, ketones are characterized by carbonyl groups (C=O).

There are various combinations of hydroxyl groups in molecules along with carbonyl groups and these combinations can lead to hydroxyketones and aldehydes as well as to carboxylic acids. Esters, and amides also have carbonyl groups (C=O) but differ in their combination with an additional structural feature. Esters, and amides also have carbonyl groups (C=O) but differ in their combination with an additional structural feature.

According to (Koay *et al*., 2006) from commercial grade palm oil based crude oleic acid consist three functional groups, one carboxyl functional group and two hydroxyl functional groups.

The following is a list of common functional groups. In the formulas, the symbols R and R' usually denote an attached hydrogen, or a hydrocarbon side chain of any length, but may sometimes refer to any group of atoms.

Table 2.1: List of Functional Group

Functional Group	**Formula**	**Structural Formula**
Alkane	R	
Alkene	HRC=CRH	
Aldehyde	RCHO	
Ketone	RCOR	
Carboxylic Acid	RCOOH	
Ester	RCOOR	
Ether	ROR	
Alcohol	-OH	

2.3 Liquid-solid extraction

There are various type of separation process such as distillation, drying, adsorption, filtration and extraction. (Geankoplis, 2003) Extraction is one of the process that being use to extract the specialty oil from fruit, seeds and many more. This is because there are found chemical compound inside the mixture in solid phase. Then, to get the compound inside the solid phase material, it needs solvent as a medium to get the specialty oil inside the material.

The process is also known as solvent extraction (liquid-solid extraction). Solvent extraction is usually using in extract the specialty oil from the seeds and fruits. This method is not suitable for the food industry because the solvent is dangerous to the human and it cannot be eat. The advantage of this process is it can extract almost all the oil inside the fruits and seeds.

Hexane is one of the solvent that can be use as a solvent extraction. This solvent have low boiling point which is 69^{o}C. It usually use as solvent because it can prevent the chemical compound from damage or overheated.

Oil extraction involves various preliminary operations, such as cleaning, dehulling, drying and grinding. However, the total amount of extracted oil depends mainly on the extraction time and temperature, moisture content and particle size of the oil-bearing materials. The greatest amount of oil is extracted during the first 20 min of extraction, and as moisture content decreases, oil recovery increases (Bernardini, 1982)

2.4 Soxhlet Extractor

Invented by Franz von Soxhlet, a German agricultural chemist who died in 1926, Soxhlet apparatus has long been used in extracting fatty or other material with a volatile solvent.

A Soxhlet apparatus comprises a vertical glass cylindrical extraction tube that has both a siphon tube and a vapor tube that is fitted at its upper end to a reflux condenser and at its lower end to a flask so that the solvent may be distilled from the flask into the condenser. From the condenser the solvent in liquid phase flows back into the cylindrical tube which holds the sample to be extracted in a porous thimble. When the solvent level rises to the top of the siphon tube the solvent, with the extracted materials, is siphoned over into the flask, to be distilled again, and thus start another cycle.

The advantage of the Soxhlet extractor is that once the contaminants and lipid material are brought into solution, and siphoned back into the flask, they stay in the flask, so that the sample in the extraction thimble is continuously re-exposed to fresh, heated solvent--thus greatly increasing the extraction rate. Figure below shown the diagrammatic of the Soxhlet extractor.

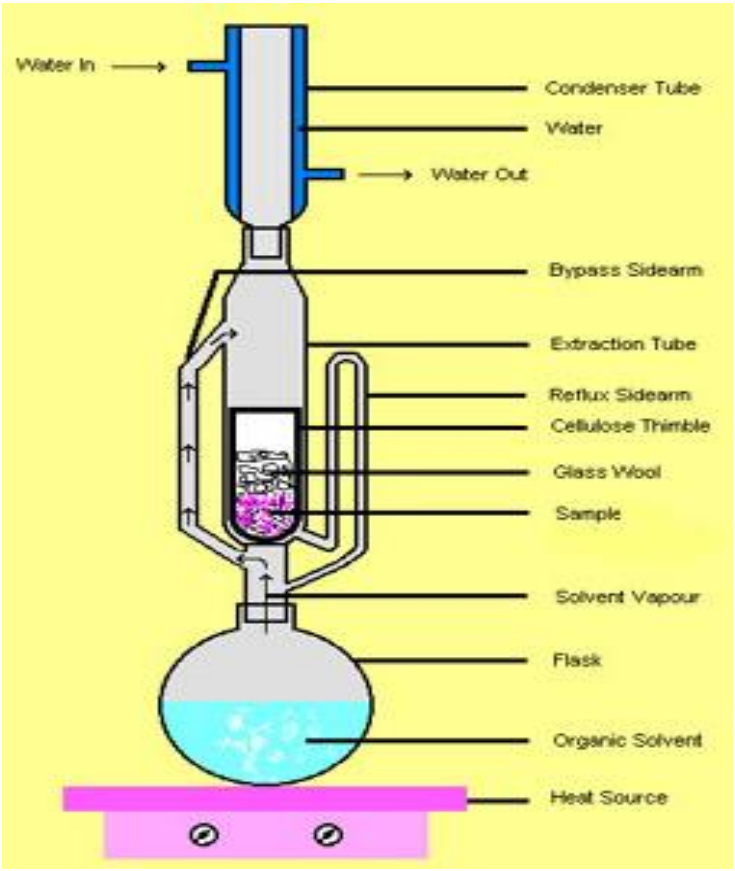


Figure 2.1: Diagram of Soxhlet Extractor

2.5 Fourier Transform Infrared Spectroscopy (FTIR)

Nowadays FTIR is certainly one of the most important analytical techniques available. One of the great advantages of FTIR is that any sample in any state can be studied and short time to obtain data. Liquid, solutions, pastes, powders, films, fibers, gases and surfaces can all be examined. Infrared (IR) spectroscopy has been recognized as a powerful analytical technique in the food industry for many years (van de Voort, 1992) and it has been employed to measure some quality parameters of oils (van de Voort, *et al*., 1992; Dubois *et al*., 1996).

FTIR is the equipment that based on vibration of atoms of a molecule. An infrared spectrum is commonly obtained by passing infrared radiation through a sample and determining what fraction of the incident radiation is absorbed at a particular energy. The energy at any peak in an absorption spectrum appears correspond to the frequency of a vibration of a part of sample molecule (Stuart, 2005)

Fourier transform infrared (FT-IR) spectroscopic instrumentation, the application of this technique expanded in food research and particularly has become a powerful analytical tool in the study of edible oils and fats. FT-IR spectroscopy is a rapid, non-destructive technique with minimum sample preparation necessary. It allows the qualitative determination of organic compounds as the characteristic vibrational mode of each molecular group causes the appearance of bands in the infrared spectrum at a specific frequency, which is further influenced by the surrounding functional groups. (Vlachos. *et al*., 2006)

The basic principle behind the technique is based on the vibrational motions of atoms and chemical bonds within organic molecules. When a beam of light containing the mid-IR radiation band is passed through a sample, light energy from the photons is absorbed by bonds and transformed into vibrational motions (Gough, 2003).

Library searching in the mid-IR region is a well established and powerful way of classifying and identifying compounds. Computer software compares the measured spectrum with every spectrum in a selected library. Comparison is usually accomplished by subtracting the measured spectrum from each spectrum in the library. The software keeps track of the number of differences found for each library spectrum. The best matches are those with the fewest differences. Computer reports the best match, second match, etc. Operator should still do a visual comparison with reference data for positive identification. On the basis of the above mentioned literatures, the present work aimed at the applications of FTIR spectroscopy as a rapid, cheap nondestructive, authenticity measuring tool to asses the adulteration of extra virgin olive oil with other edible oils such as corn, sunflower or soybean oils. (Allam *et al*., 2007)